

Regarding some Mesozoic Ores.

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There are several places in the New Red Sandstone where, although the presence of no other formation within several miles is intimated on the old map, nor has any sudden change of character in the rock been suspected, there nevertheless appear to be good reasons for supposing that the outer shell of the Mesozoic strata has been worn through and the underlying and older formation has been exposed. One instance (of not much weight, owing to its very local character and its proximity to the actual boundary between the two formations) occurs near Franklinton, York County, near Lerew's tavern, where an oval piece of ground seems to be composed entirely of the older schists, while the contiguous country is made up of the newer shales and sandstones.

The same thing may be noticed near Bendersville and near Arendtsville, where small islands of Mesozoic seem to stand out in a sea of Huronian schists and débris. Many such instances taken from other formations will occur to every geologist, and a glance at the State geological map of the last survey will convey the same fact forcibly through the eye to the mind; for there it will be seen that not only are the bounding edges of the formations ragged, and the shreds of one left within the domains of the other, but (sometimes on account of the geographical and orographical conditions under which the original deposition of beds took place; and sometimes owing to the peculiar action of erosion) great peninsulas, islands and archipelagos, are to be seen distinguishing themselves from the formation in which they lie by the colors chosen by Prof. Rogers to represent them.

Such, for instance, are the strips of what Prof. Rogers called Primal and altered Primal which stretch out like an Aleutian chain in the limestone sea of Lancaster and York Counties.

So far as this occurrence of the Huronian rocks within the limits of the New Red Sandstone is concerned, it is important in more ways than one.

1st. As accounting for the presence in the newer of many constituents characteristic of the older rocks in other parts of the country (magnetite, copper ore, etc.); and 2d, in resolving the doubt as to the comparative thickness of the New Red Sandstones at adjacent points.

It has long ago been suggested that the presence of the iron "Glances" in the red shales and sandstones, and the presence in the latter of more or less well defined belts of copper ore, might be accounted for on the supposition that in the making of the newer beds the older were ground up and redistributed (*re-sedimented* would better express the idea).

We know as a fact, adverted to elsewhere, that the only horizons in which copper ores have been found in this State are the South Mountain series of crystalline schists, etc., and these very rocks in question. And even if we seek elsewhere in this country, except a very limited deposit in the Medina

group, and the lean copper shales of the Catskill, none but still more insignificant exhibitions have been noted in other formations.

It might be easier to account for cupriferous shales and sandrocks in the Triassic beds were we sure that ferriferous and cupriferous Huronian rocks were actually in contact with their lower surface, and provided also we could find evidences of such cupriferous and ferriferous horizons among the rocks of the South Mountain system, which are evident lateral continuations of the bed of the Mesozoic sea.

It is true that a copper horizon has been noted in the Orthofelsite of the South Mountain, as at Watson's, Snyder's, etc. in Adams County near Monterey; and deposits of Micaceous and Specular Iron Ore of very great beauty at G. Coles' near the summit of the Gettysburg-Chambersburg turn-pike (both of these in the Huronian series): and also that many minor occurrences of specular and magnetic iron ore disseminated through the rock in minute crystals (as in specimens found on Green Ridge near Caledonia Springs, etc.); but all the deposits thus far discovered will not account for the exceptionally rich character of that portion of the Mesozoic beds which abuts upon the eastern flank of the South Mountain.*

In my report of progress for 1875 (Second Geol. Survey of Penn. CC, p. 328), I have given reasons for the rejection of any theory which implies a local deposit of these ores (*i. e.* only along the borders of the formation), and I have cited eleven localities scattered over the length and breadth of the Mesozoic belt in York and Adams Counties where micaceous ore appears—more or less mixed with magnetite. The copper horizon of Phoenixville seems at first sight to agree well with the views advanced by Dr. Hunt and others concerning the restriction of the metalliferous strata to the two edges of the New Red, for Phoenixville lies very near the southern edge of this formation on the Schuylkill, where it has dwindled down

* Dr. T. Sterry Hunt, in a recently published paper on the "Cornwall Iron Mine and some related deposits in Pennsylvania," states as follows:

"But I have now to bring to your notice" * * * "those ores which are found over Pennsylvania along both borders of the Mesozoic red sandstone formation which stretches through the State; including on the south side the ores of Warwick and the Jones Mine, and on the north side a line of deposits from Boyertown and the vicinity of Reading to beyond the Susquehanna, including the great Cornwall Mine near Lebanon."

"These ores were by Prof. Rogers referred to what he designates the Primal slates, which he regarded as the lowest member of the Palæozoic series, though by some later observers the Cornwall Mine and certain related deposits west of the Susquehanna have been referred to the Mesozoic sandstone. It would be foreign to my present purpose to set forth the reasons which lead me to conclude that these are, all of them, really contemporaneous deposits included in the Primal slates, which corresponds to a portion of the lower Taconic series of Emmons, and belong, in my opinion, to a lower horizon than the Potsdam sandstone of the New York system. *That they are met with only along the borders of the Mesozoic sandstone formation is due to the fact that those ancient ore-bearing rocks, from their decayed condition and their inferior hardness, have been removed by denudation, except when protected by the proximity of the newer sandstones or of eruptive rocks, as is the case at the Cornwall Mine.*"

(Transactions American Institute of Mining Engineers, Vol. IV, p. 320.)

to about half the breadth which it exhibits on the Delaware. It is worthy of note that this contraction of the area of the New Red has been brought about by a sloping inwards towards the median line of both its north and south boundaries, so that if the breadth of the Mesozoic rocks on the Delaware were continued to the Maryland line, this ore région would fall but little below the axis of the belt. Furthermore, this position would accord well with that of the copper ore deposit in Bonnaughtown, about eight kilometers (or five miles) east of Gettysburg.

The same argument may be applied to the iron ores of the Altland mines, which are cut in specular, somewhat magnetic and very cupriferous ore, for this locality lies 11 kilometers (or 6 $\frac{2}{3}$ miles) S. E. of the N. W. limit of the New Red.

If the same view be held to explain the Cornwall deposit and the Altland deposit the latter must be of ante-Potsdam age. This, however, is not at all yet sustained by observation.

Again, if the source of all this magnetic-micaceous ore be assumed to be the older slates, then it seems to indicate that the greater part of the sand obtained by wearing the shores of the Mesozoic sea was obtained from the Huronian rocks, for over every kilometer ($\frac{2}{3}$ mile) of the breadth of the deposit in York and Adams will be found *some* flaky "iron-glimmer," besides many belts of shale and sandstone, colored green with the débris of the Huronian chlorites and sparkling with the hydro-micas of the same age.

Now supposing that this were true, *i. e.* that either the greater part of the Mesozoic sandstone rocks, or at least a large proportion of them, taken in any part of the belt, consisted of the débris of the Huronian schists worked over, it might prove a connection between these ore deposits, but a few miles from the South Mountain, and those of the latter: independently of whether the shallow but monoclinal structure of these beds (as explained by the wave strewing hypothesis of H. D. Rogers; or the deepening trough-bottom hypothesis of J. D. Dana),* or the normal deposition, folding and subsequent erosion shall be assumed, for even in this latter case a margin of a certain width along the coast line, where the water was shallow, would show in the deposits the characters of the original rock forming its shelving bottom.

So that in any case we should look for the Huronian source under the present position of the ore, because the waves which broke up the shallow bottom would strew the débris in the immediate vicinity of the parent rock.

[In Rogers' hypothesis the direction of the apparent motion of the wave is the really important factor, and it is difficult to understand why we should not have S. E. dips on the S. E. margin of the Mesozoic estuary, since the waves are supposed to produce layers dipping in shore. (See diagram, Vol. II, Part II, p. 812, Final Report on the Geology of Pennsylvania.)† Or vice versa if the *suspension* hypothesis (*ibid.* diagram p. 813) be preferred.]

But, abandoning this wave-strewing hypothesis as altogether inadequate

* Manual of Geology, 1875, p. 421. † 1858.

to account for beds of such depth as those we find in the New Red, we may nevertheless consider the effect of the waves in forming strata of sediment in the shallow portions adjacent to the coast (which here seems to have been the South Mountain).

The direction of the line of Section 7, Report for 1875 C C (which corresponds with the South Mountain portion of the Section of the same number in Roger's final Report) was chosen, after an examination of the plotted work in that region permitted a mean of all the mountain dips to be taken. The direction of this mean dip was chosen as the direction of the section line because it was the line most nearly corresponding with all the observed dips. A direction perpendicular to this will therefore represent with the nearest approach to exactness the strike of the old Huronian rock.

These mean dip and strike lines are constant for the entire portion of the South Mountain here under consideration.

This strike is E. 27° N.

The strike of the New Red Sandstone rocks contiguous to the above Huronian rocks was calculated in the same way, for Section 6a (the nearest Section) and is E. 40° N.

These lines thus intersect each other at an angle of 13° .

If we assume that all the New Red Sandstone rocks which cover a strip of country from 10 to 12 kilometers ($6\frac{1}{4}$ to $7\frac{1}{4}$ miles) from the base of the South Mountain were parts of the shallow or littoral Mesozoic sea, and therefore especially subjected to the wasting action of the waves; it is natural that the ore belt of the new forming rocks must follow approximately the ore line below, and since only in a limited margin beyond the actual breadth of the parent bed is it likely that the ore would show in the new formation, it might appear as if deposited in a vein more or less clearly defined, and following a course of about E. 27° N. It should be here emphasized that this might be so independently of the accuracy or error of the wave-strewing hypothesis, and independently of whether their present dips were acquired then or subsequently; provided only that the new rocks were forming on, and from the old. But whether or not this be the case, the following phenomena are interesting.

The mines known as the Dillsburg Group lie too close together to enable one to predicate anything with confidence from them alone as to the direction of the one or more belts of ore in which they are sunk, but if we connect together the three northeasternmost ore properties mentioned in General Map C C 1875. (Meyer's, Ellicker's and Kimmel's) with the group around Franklinton, the line is very nearly E. 25° N. *i. e.* that of the above mentioned strike of the Huronian measures. Moreover there does seem to be a certain conformability of the Dillsburg and other groups to this line. [N. B.—The strike of sandstone 60 ft. down in the Altland bank group is about E. 30° N.—nearly the same.]

It chances that the average dip of the South Mountain rocks remains pretty uniform from N. E. to S. W., so that if there were any foundation

for the supposition, we ought to be able to follow one or more belts of ore in a tolerably straight course from one formation into the other.

On the general map to illustrate the report of 1875, lines were drawn from the Franklinton ore diggings, E. 27° N. and W. 27° S. The first of these passes through the locality where ore has been prospected at Meyers', Ellicker's, and Kimmel's. The W. 27° S. line passes through the town of Whitestown (or Idaville), where was a once famous iron mine. All these three occurrences are clear of the mountain range. The first two are in the New Red, the last in the older (Huronian) crystalline schists or in the mixed marginal formation. Continuing this line still further W. 27° S. it cuts the very singular ore mine of G. Coles in the Catholic Valley (a small valley among the South Mountain ridges). This same line emerges in the Cumberland Valley where several new ore pits sunk by Col. Wiestling have proved the existence of ore.*

Drawing a parallel line of W. 27° S. from the Dillsburg group, we cross the Bender, McCormick and Williams limonite mines in the first high land of the mountains about 6.5 kilometers (or a little more than four miles) S. W. of Dillsburg. Near the Chambersburg turnpike this line crosses the "Furnace bank" opening, which can be seen from the turnpike on the brow of a steep hill just across (W. of) the Connococheaque.

If we move the parallel ruler from this line till it pass through Pine Grove, and draw another line, this latter will very nearly pass through Medler and Sayler's and the Thomas Iron Co.'s banks S. E. of Papertown, in one direction, and through the Hoosac Run Mine of the old Caledonia Furnace property in the other, emerging from the mountains near the mouth of Cold Spring Ravine at the ore opening of Mr. Good.

Thus it will be remarked that not only does the characteristic strike line of the old Huronian rocks enable us to pass from known ore localities in the older, to known localities in the newer formation; but all the important mines of this particular region yet known in both formations can be connected together by two or three such lines.

* It is doubtful if the latter is more than a coincidence, as the portion of this line between Coles' ore mine and the Cumberland Valley probably crosses the line of a great fault and thrust: the most important dynamic element in the formation of these mountains.